



The VALUE portal: Validating downscaling approaches for climate change studies

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*Presently at Dept. of Physics,
AOPP, Oxford Univ.*

on behalf of

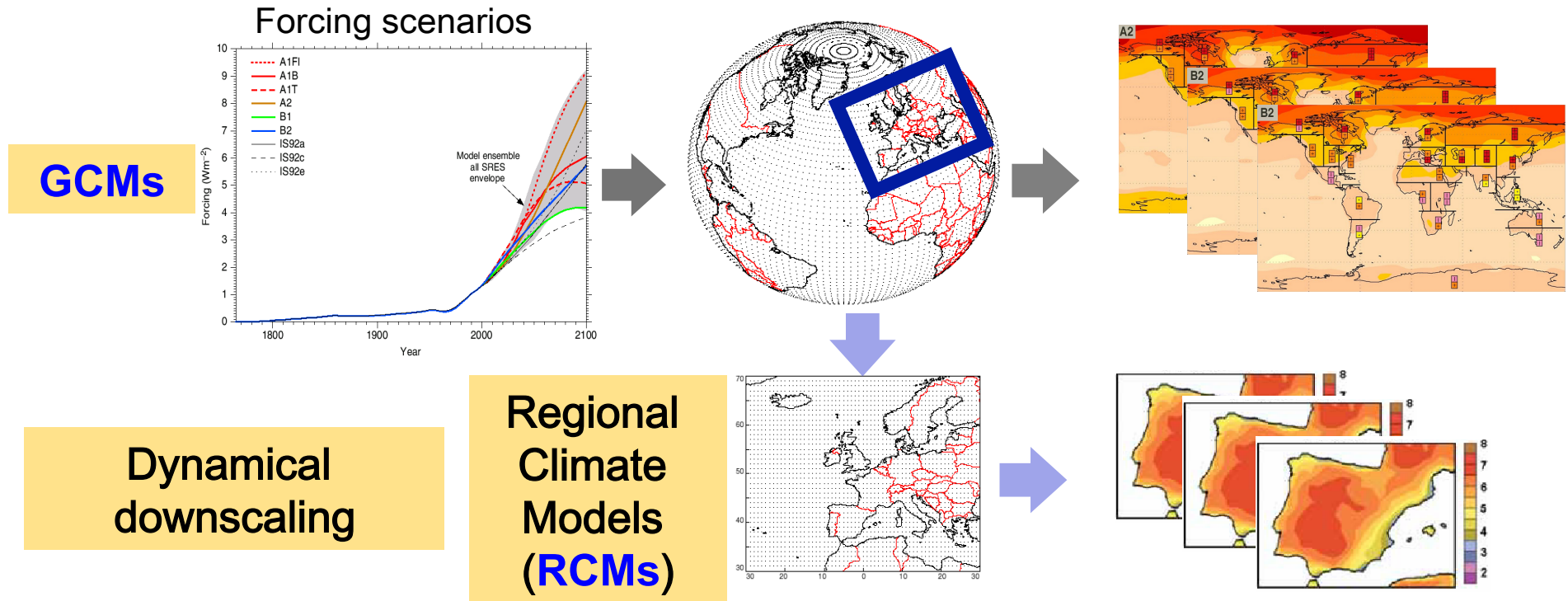
<http://www.value-cost.eu>



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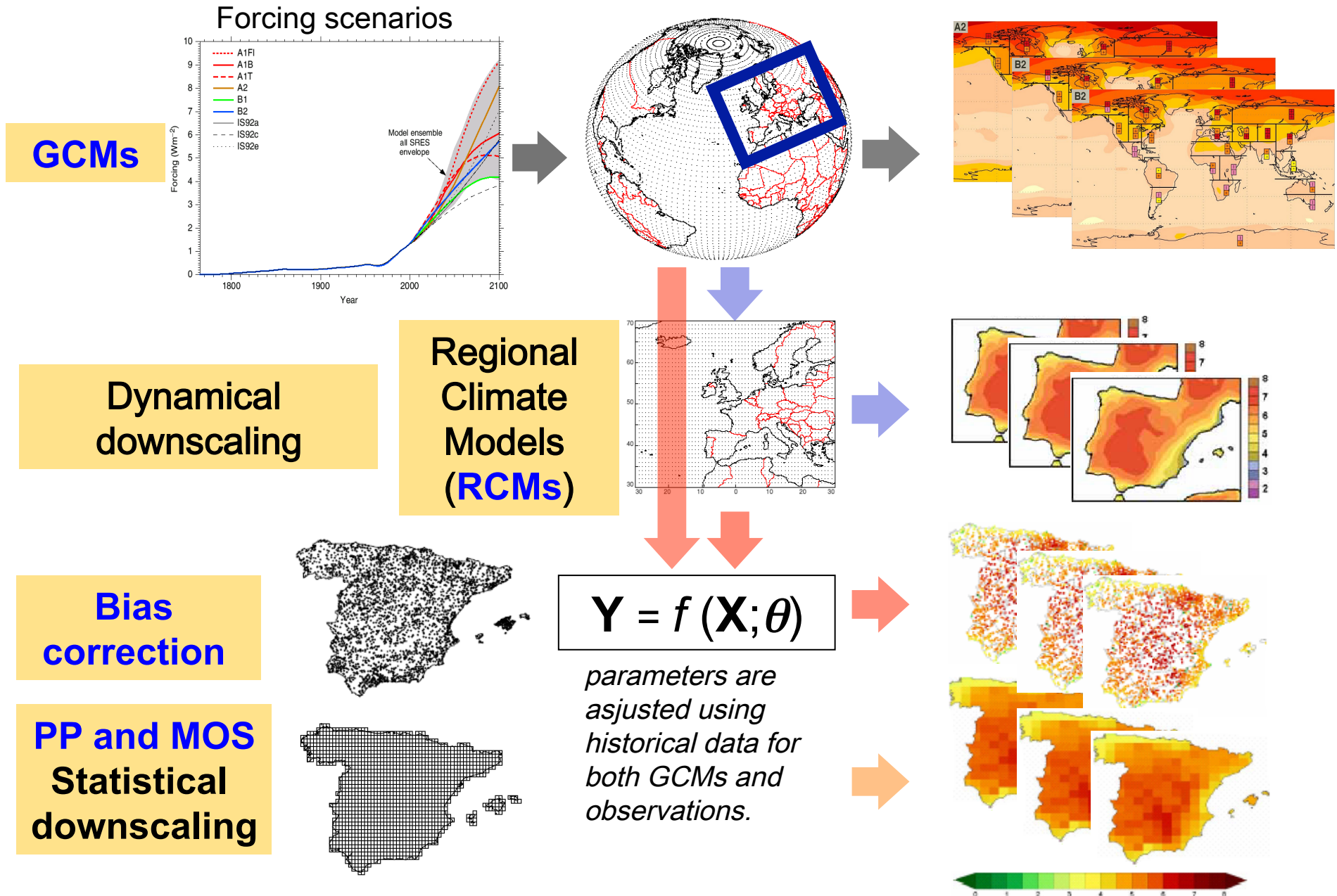
Downscaling approaches



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Downscaling approaches



- **Model Output Statistics (MOS):** The model is trained using observations and GCM outputs (which include biases/errors).

$$\text{precip}_{\text{obs}}[d] = f(\text{precip}_{\text{gcm}}[d])$$

Introduced for weather forecasting (Glahn and Lowry, 1972) using pair-wise predictions-obs, **but problematic for climate projection.**

Adapted for climate projection under the name “**bias-correction**” in a distributional-wise approach:

$$\text{PDF}(\text{precip}_{\text{obs}}) = F(\text{PDF}(\text{precip}_{\text{gcm}}))$$

- **Perfect Prognosis (PP):** The model is trained using observations and reanalysis (quasi-observations). Predictors are large-scale variables well represented by GCMs.

$$\text{precip}_{\text{obs}}[d] = f(\text{SLP}_{\text{rea}}[d], \text{Q850}_{\text{rea}}[d])$$

BIASES

RESOLUTION

BIASES

RCMs

BIASES

RESOLUTION

GCMs

VALUE is an open European network to systematically **validate and compare (dynamical and statistical) downscaling methods for climate change research.**

Different (**cross-validation**) experiments have been designed to identify different problems that might occur in the downscaling procedure

- **Perfect (*ERA-Interim*) Predictor**
- **GCM (*CMIP5*) Predictor**
- **Pseudo Reality (*RCM as predictand*).**

Predictands:
stations and/or (0.11°) grids

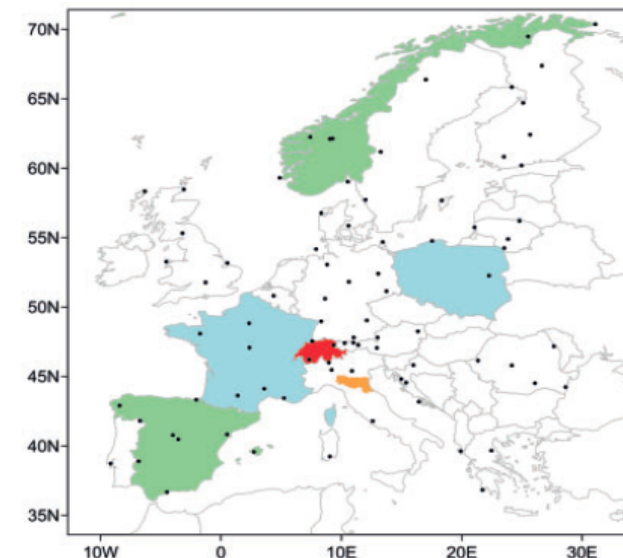


Figure 4. Validation Domains and Data. Green: gridded data without registration; blue: gridded data with registration; orange: sub-daily station data. Red: gridded data for use by VALUE members only. Additionally, publicly available daily station data across Europe will be selected. Black dots: selection of 85 stations.

RESEARCH ARTICLE

VALUE: A framework to validate downscaling approaches for climate change studies

Douglas Maraun^{1,*}, Martin Widmann²,
José M. Gutiérrez³, Sven Kotlarski⁴,
Richard E. Chandler⁵, Elke Hertig⁶,
Joanna Wibig⁷, Radan Huth⁸ and Renate
A.I. Wilcke⁹

Article first published online: 7 JAN 2015

Issue



Earth's Future

**Early View (Online Version of
Record published before
inclusion in an issue)**

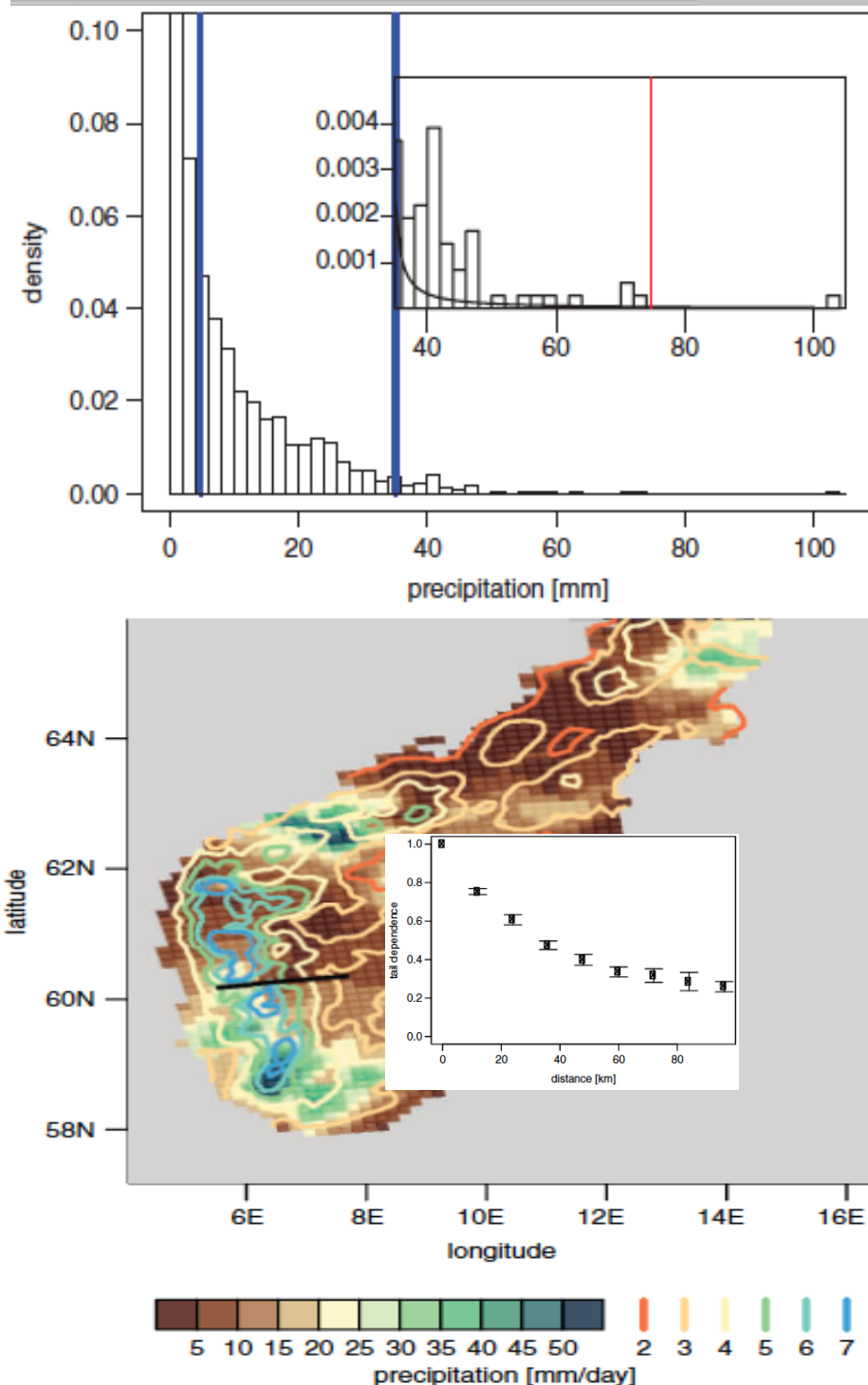
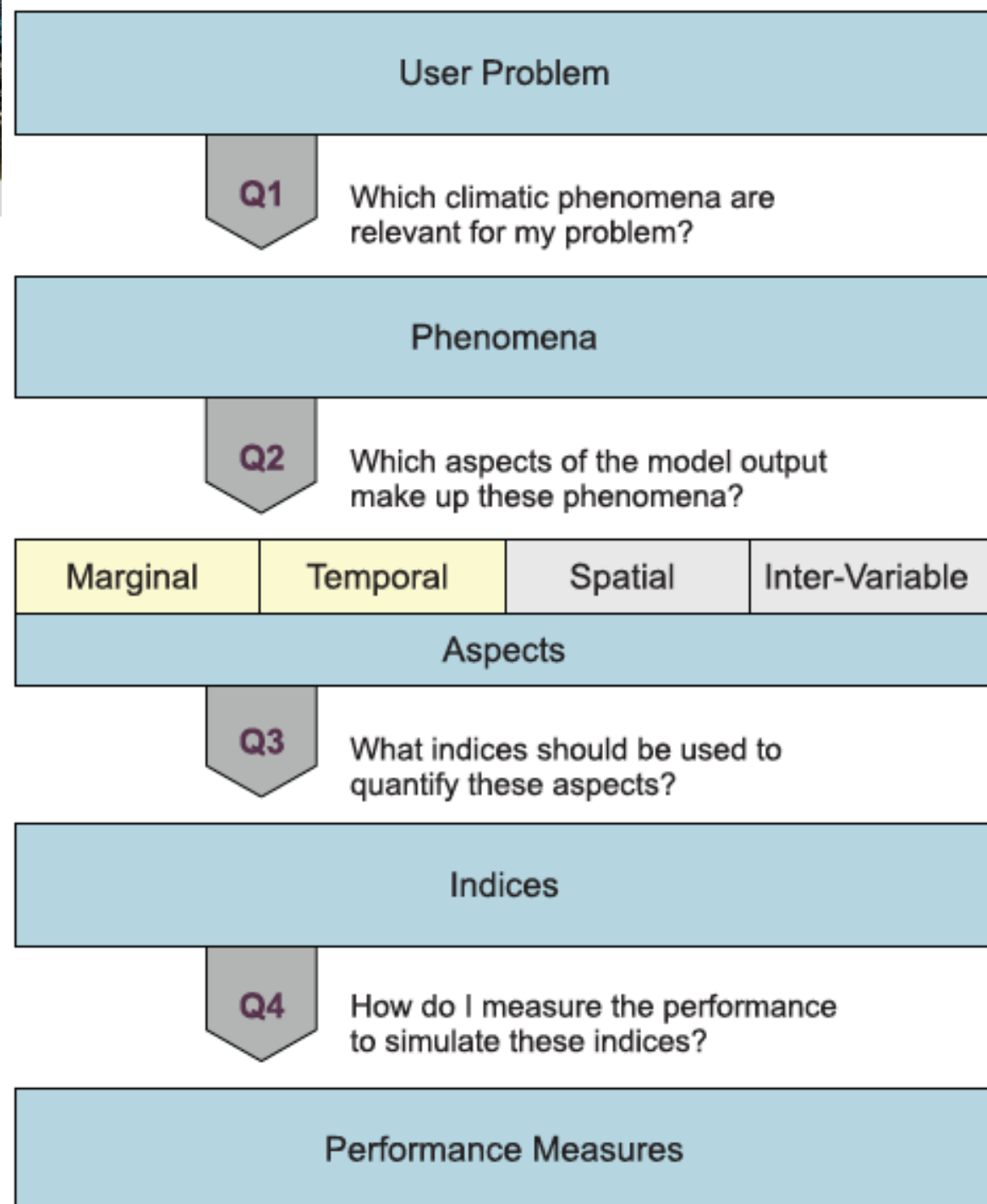


Figure 1. Validation Tree. Grey arrows: selection questions. Beige: tier I aspects; gray: tier II aspects.

Figure 3. Spatial aspects. Top panel: filled grid boxes: total precipitation on 23 June 2000. Contour lines: climatological average daily summer precipitation (1980–2010). Bottom panel: empirical tail dependence coefficient as function of grid-box distance along the black line in left panel.

Santander Meteorology Group*A multidisciplinary approach for weather & climate****Validation R-package*****Table 1.** List of Example Indices^a

Aspect	Index	Performance Measure
Marginal	mean	bias/relative error
	variance	relative error
	20 season/year return level	bias/relative error
	number of threshold exceedances	bias
Temporal	time series	mean squared error/ correlation
	ACF lag 1, 2, 3	N.A.
	median of spell length distribution	bias
	90th percentile of spell length distrib.	bias
	minimum/maximum of annual cycle	bias/relative error
Spatial	decorrelation length	relative error
	variogram range	relative error
	decay length of tail dependence	relative error
Multivariate	Pearson/rank correlation	N.A.
	probability of joint exceedances	N.A.
	indices conditional on (no) exceedance	as above

^aThe complete list of indices may be found on www.value-cost.eu/indices. In some cases, model and observational indices will be affected by high uncertainties. Here no performance measures will be calculated (N.A. in the table), but just the index values will be given.



The functions for calculating the different indices and performance measures (as well as data access and wrapping functions) have been implemented as a collaborative R package, publicly available in *GitHub*.

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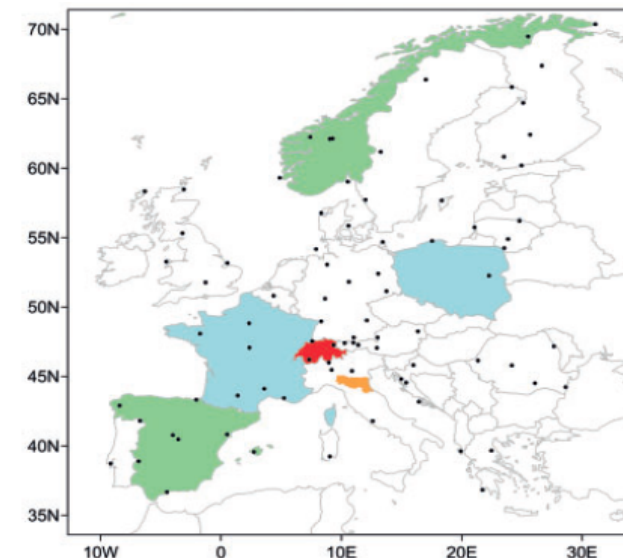


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Experiment 1 ... in progress



VALUE: COST Action ES1102 (2012-2015)

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CONTRIBUTE TO THE VALIDATION

Validating and Integrating Downscaling Methods for Climate Change Research

Project Objectives Members Contact

Our understanding of global climate change is mainly based on General Circulation Models (GCMs) with a relatively coarse resolution. Since climate change impacts are mainly experienced on regional scales, high-resolution climate change scenarios need to be derived from GCM simulations by downscaling. Validation of downscaling methods is crucial, but several aspects have not been

Validation experiments

- [How to contribute & register](#)
- [Experimental framework](#)
- [Validation portal](#)

A web portal has been developed to **collect, validate, visuallize** and **publish** the validation results (and data) in a user-friendly way.



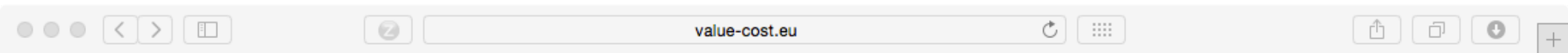
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Contribution from 23 groups

Intended Contribution to Experiment 1a

Q	responses	
1	Region	
	European Wide	13
	Country	4
	Only some stations	5
2	Approach	
	Perfect prog/empirical statistical downscaling	15
	MOS/bias correction	6
	Weather generator w/o atmospheric predictors	1
3	Technique	
	no atmospheric predictors	1
	Analog based	7
	Regression based	10
	Bias correction (additive/relative)	2
	Quantile mapping	7
	Other	2



VALUE: COST Action ES1102 (2012-2015)

Validating and Integrating Downscaling Methods for
Climate Change Research

Username

Password

[How to contribute and register](#)



Login

VALUE Validation Portal

- Home
- Datasets
- Experiments
- Methods
- Upload
- Validation
- Jobs



Logout

value-cost.eu

- [Description](#)
- [Deadlines](#)
- [News](#)
- [Contact](#)

Welcome to the VALUE validation portal!

[VALUE](#) (EU COST Action ES1102) is an open European network to systematically validate and compare (dynamical and statistical) downscaling methods for climate change research. Different experiments have been designed to identify different problems that might occur in the downscaling procedure. The experiments differ in the type of predictor data and boundary conditions, the predictand data, and the space and time scales considered. For each applicable experiment, contributors will select a set of predictors or boundary conditions as input to their downscaling method, and upload the downscaled results to the VALUE portal for a centralised validation. For statistical methods, the downscaled results for validation will be generated according to a prescribed cross validation procedure.

Please read prior to participation

[Experiment Protocols](#) (details about predictors, predictands, cross validation, and upload)

[Framework Paper](#) (detailed discussion of the VALUE validation framework)

[Terms and Conditions](#) (details about data policy)

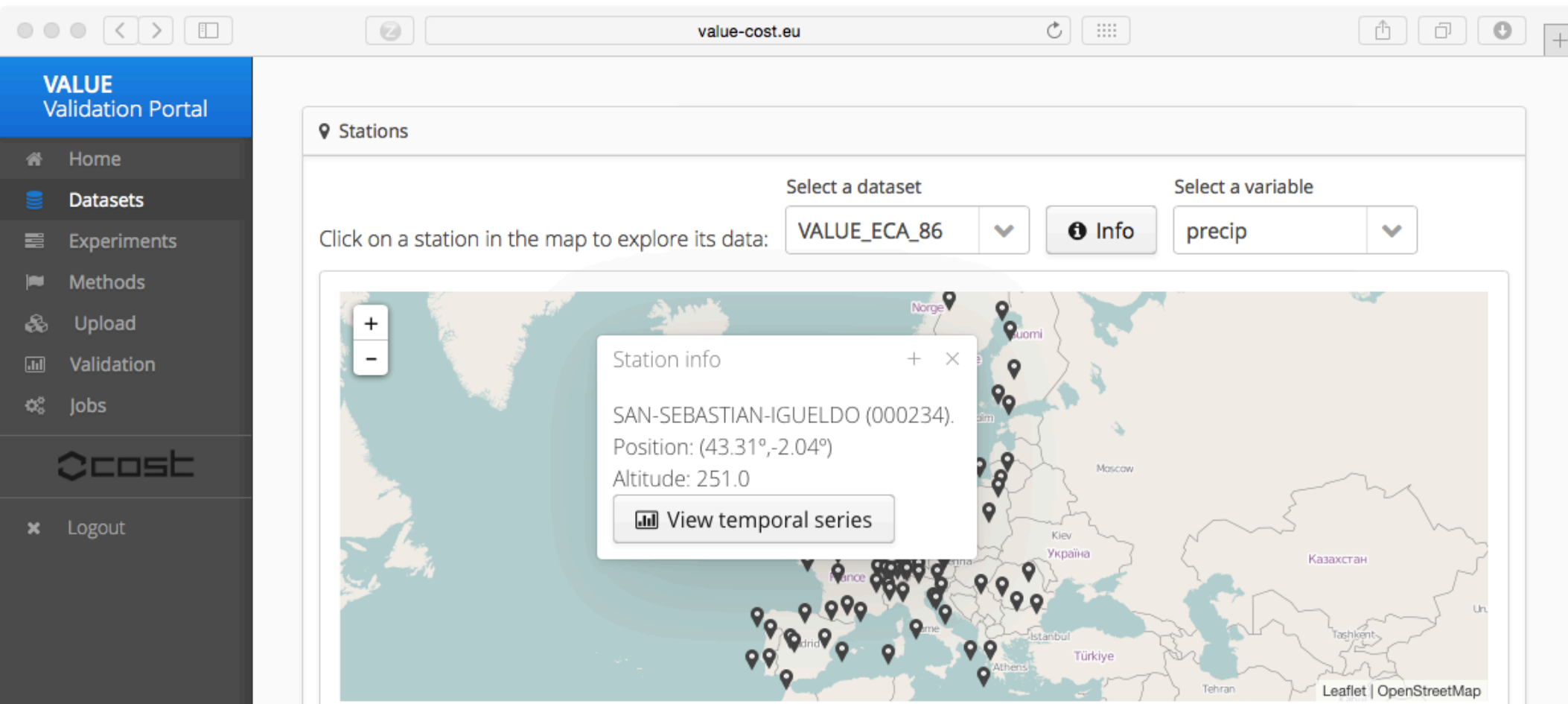
Portal description

Datasets: visualisation of predictand data. See protocol for actual download of predictor and predictand data.

Experiments: selection of experiments. Currently only *experiment 1a*.

Methods: specification of the downscaling methods a participant wants to validate.

Visualize (download) the available datasets.



The screenshot displays the VALUE Validation Portal interface. On the left is a dark sidebar with navigation links: Home, Datasets, Experiments, Methods, Upload, Validation, Jobs, and a Logout button at the bottom. The main content area has a header 'Stations' and a prompt 'Click on a station in the map to explore its data:'. Above the map are two dropdown menus: 'Select a dataset' (currently showing 'VALUE_ECA_86') and 'Select a variable' (currently showing 'precip'). An 'Info' button is located between these dropdowns. The map shows Europe with numerous black location pins. A pop-up window titled 'Station info' is open over a pin in northern Spain, displaying the following details: 'SAN-SEBASTIAN-IGUELDO (000234)', 'Position: (43.31°, -2.04°)', and 'Altitude: 251.0'. Below the altitude is a button labeled 'View temporal series' with a small bar chart icon. The map includes zoom controls (+/-) on the left and 'Leaflet | OpenStreetMap' in the bottom right corner.

Access to predictors is given through the UC climate data service (building on a TDS).

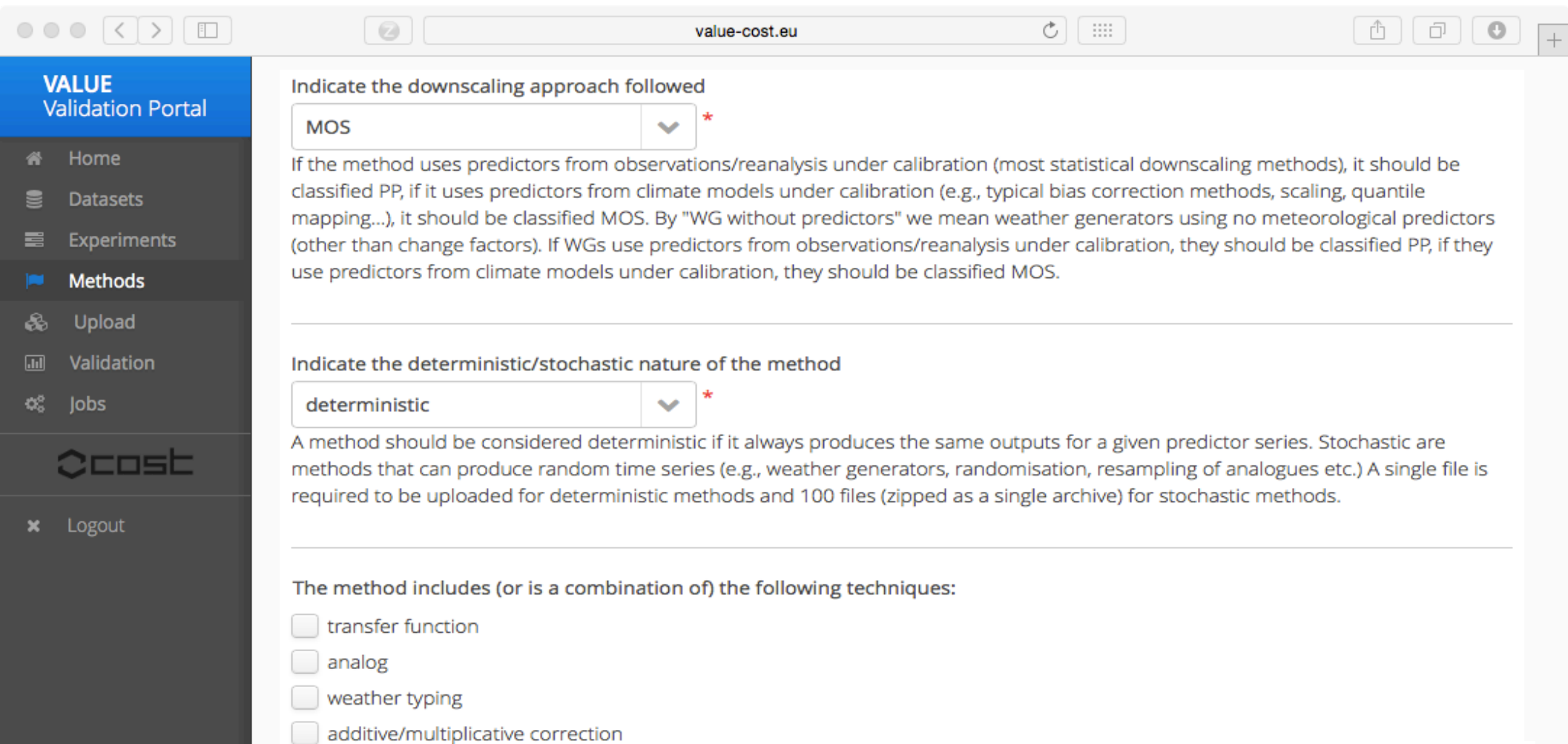
Check the available experiments.

The screenshot displays the VALUE Validation Portal interface. The browser address bar shows 'value-cost.eu'. The left sidebar contains navigation links: Home, Datasets, Experiments (selected), Methods, Upload, Validation, and Jobs. The main content area shows a table of experiments. The first experiment, 'Experiment_1a', is highlighted, and its details are shown in a modal window.

Experiment name	Description	Dataset	Cross-Validation	Type	Info
Experiment_1a	k-fold crossvalidation for the peri...	VALUE_ECA_86	K-Fold	Standard	i Info

Experiment name	Experiment_1a
Description	k-fold crossvalidation for the period 1979-2008 (30 years) for the VALUE_ECA_86 dataset
Long Description	k-fold crossvalidation for the period 1979-2008 (30 years) considering five (k=5) six-year consecutive periods. P1: 1979-1984, P2: 1985-1990, P3: 1991-1996, P4: 1997-2002, P5: 2003-2008. The train and test phases of the downscaling methods will be repeat
Dataset	VALUE_ECA_86
Variables	precip, tmin, tmean, tmax
Cross-Validation	K-Fold
Type	Standard
Fold #1 Train	1985-1990, 1991-1996, 1997-2002, 2003-2008
Fold #1 Test	1979-1984

Define a downscaling method (metadata).



The screenshot shows a web browser window with the URL `value-cost.eu`. On the left is a sidebar menu for the 'VALUE Validation Portal' with options: Home, Datasets, Experiments, Methods (highlighted), Upload, Validation, and Jobs. Below the menu is the 'cost' logo and a 'Logout' button. The main content area is titled 'Indicate the downscaling approach followed' and has a dropdown menu set to 'MOS'. Below this is a paragraph explaining the classification of methods. The next section is 'Indicate the deterministic/stochastic nature of the method' with a dropdown set to 'deterministic' and another explanatory paragraph. The final section is 'The method includes (or is a combination of) the following techniques:' with four unchecked checkboxes: 'transfer function', 'analog', 'weather typing', and 'additive/multiplicative correction'.

Indicate the downscaling approach followed

MOS *

If the method uses predictors from observations/reanalysis under calibration (most statistical downscaling methods), it should be classified PP, if it uses predictors from climate models under calibration (e.g., typical bias correction methods, scaling, quantile mapping...), it should be classified MOS. By "WG without predictors" we mean weather generators using no meteorological predictors (other than change factors). If WGs use predictors from observations/reanalysis under calibration, they should be classified PP, if they use predictors from climate models under calibration, they should be classified MOS.

Indicate the deterministic/stochastic nature of the method

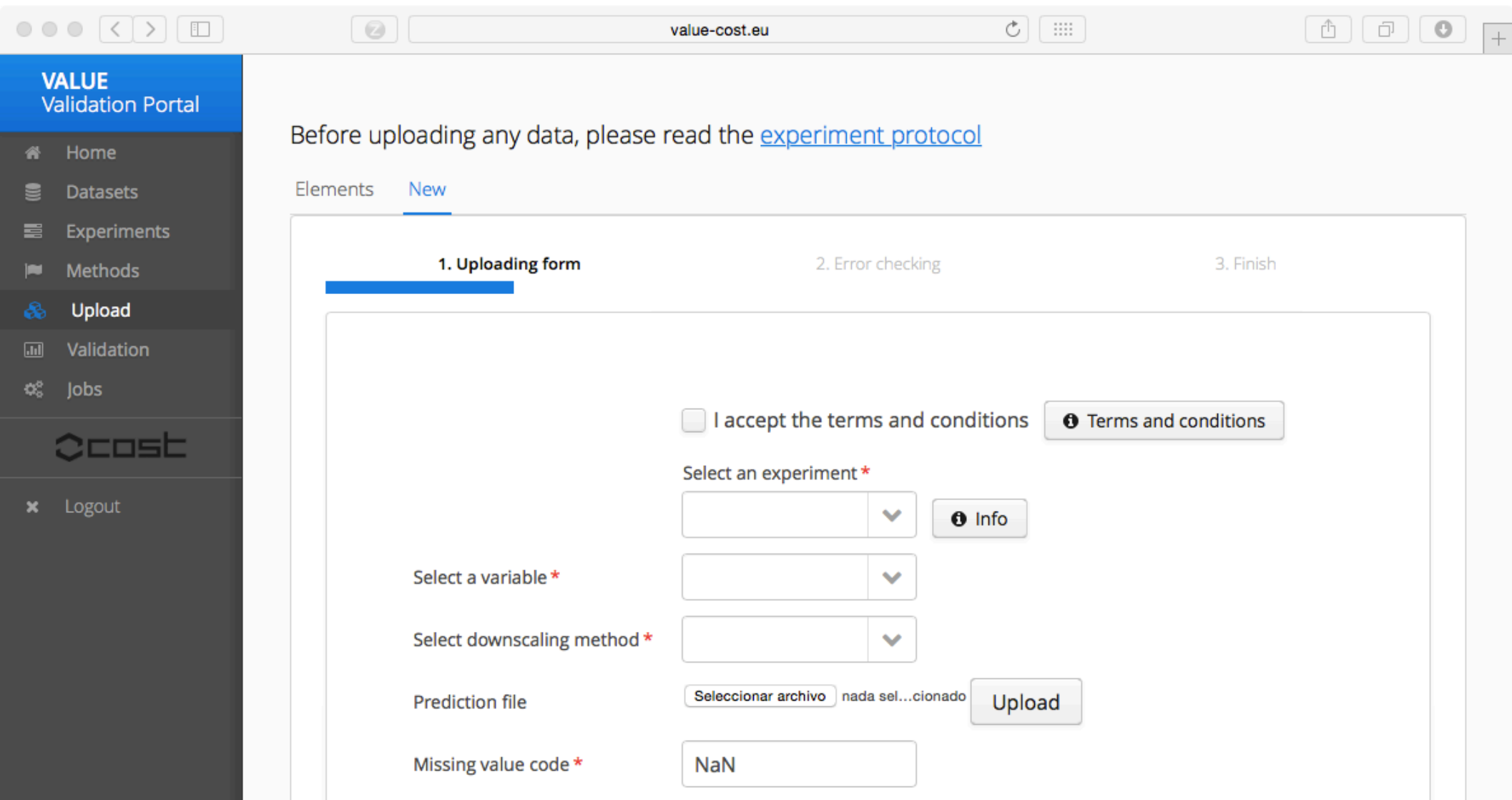
deterministic *

A method should be considered deterministic if it always produces the same outputs for a given predictor series. Stochastic are methods that can produce random time series (e.g., weather generators, randomisation, resampling of analogues etc.) A single file is required to be uploaded for deterministic methods and 100 files (zipped as a single archive) for stochastic methods.

The method includes (or is a combination of) the following techniques:

- ☐ transfer function
- ☐ analog
- ☐ weather typing
- ☐ additive/multiplicative correction

For a particular **experiment** and **variable**, using a particular **method**.



The screenshot shows a web browser window with the URL 'value-cost.eu'. The page has a blue sidebar on the left with the 'VALUE Validation Portal' logo and a navigation menu: Home, Datasets, Experiments, Methods, Upload (highlighted), Validation, and Jobs. Below the menu is the 'cost' logo and a 'Logout' link. The main content area has a header with the text 'Before uploading any data, please read the [experiment protocol](#)'. Below this is a tabbed interface with 'Elements' and 'New' (selected). The 'New' tab shows a progress bar with three steps: '1. Uploading form' (active), '2. Error checking', and '3. Finish'. The '1. Uploading form' section contains a checkbox for 'I accept the terms and conditions' with an 'Info' button and 'Terms and conditions' link. Below this are three dropdown menus: 'Select an experiment *', 'Select a variable *', and 'Select downscaling method *'. Each dropdown has an 'Info' button. At the bottom, there is a 'Prediction file' section with a file selection button labeled 'Seleccionar archivo' and the text 'nada seleccionado', and an 'Upload' button. Finally, there is a 'Missing value code *' field with the value 'NaN' entered.

value-cost.eu

VALUE
Validation Portal

- Home
- Datasets
- Experiments
- Methods
- Upload**
- Validation
- Jobs

cost

Logout

Before uploading any data, please read the [experiment protocol](#)

Elements **New**

1. Uploading form 2. Error checking 3. Finish

☐ I accept the terms and conditions [Terms and conditions](#)

Select an experiment *
 [Info](#)

Select a variable *

Select downscaling method *

Prediction file
 nada seleccionado

Missing value code *

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Visualize (download) the validation results (*and data*).

The screenshot shows the VALUE Validation Portal interface. The left sidebar contains navigation links: Home, Datasets, Experiments, Methods, Upload, Validation (highlighted), Jobs, and Admin. The main content area displays a table of validation results under the heading "Results filtering". The table has columns: Uploader, Creation time, Public, Prediction, Experiment, and Operations. The first row shows an entry by 'admin' from '2014-12-03 10:41' with 'false' public status and prediction 'testPrd-1417599262611'. The 'Operations' column for this entry includes 'Table' and 'Map' buttons. Below the table, there are controls for 'Items per page' (set to 25), pagination (Page: 1 / 1), and buttons for 'Export to Excel' and 'Export to PDF'. A yellow text box is overlaid on the table area.

VALUE
Validation Portal

- Home
- Datasets
- Experiments
- Methods
- Upload
- Validation**
- Jobs
- Admin

cost

Logout

Results filtering

	Uploader	Creation time	Public	Prediction	Experiment	Operations
	Show all	Show all	St <input type="checkbox"/>	Show all	Show all	Show all
1	admin	2014-12-03 10:41	false	testPrd-1417599262611	Experiment_1a	<input type="checkbox"/> Table <input type="checkbox"/> Map

Items per page: 25

<< Previous Page: 1 / 1 Next >>

☐ Table

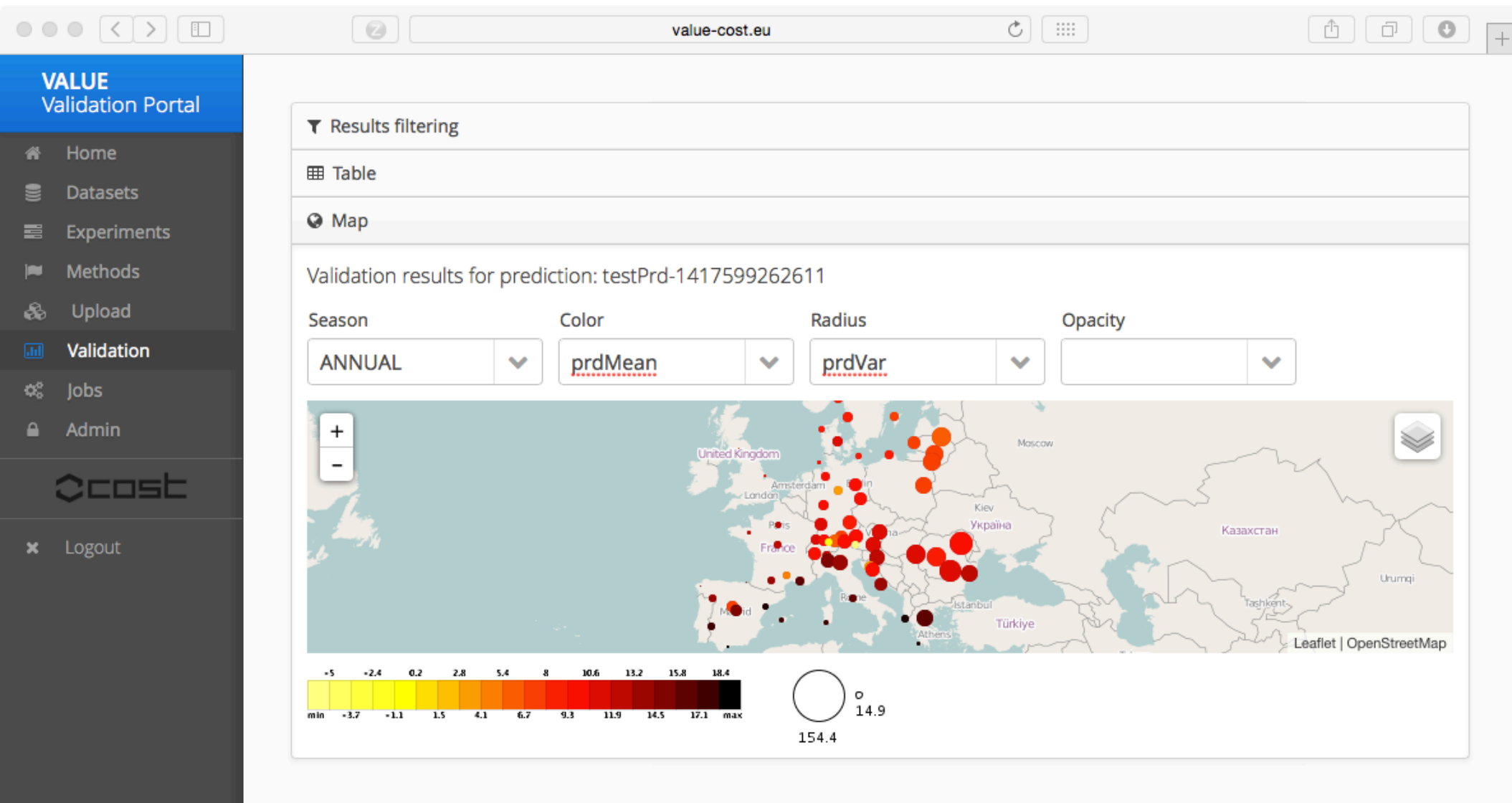
☐ Map

Users can decide whether a experiment is private of public.

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Visualize (download) the validation results.



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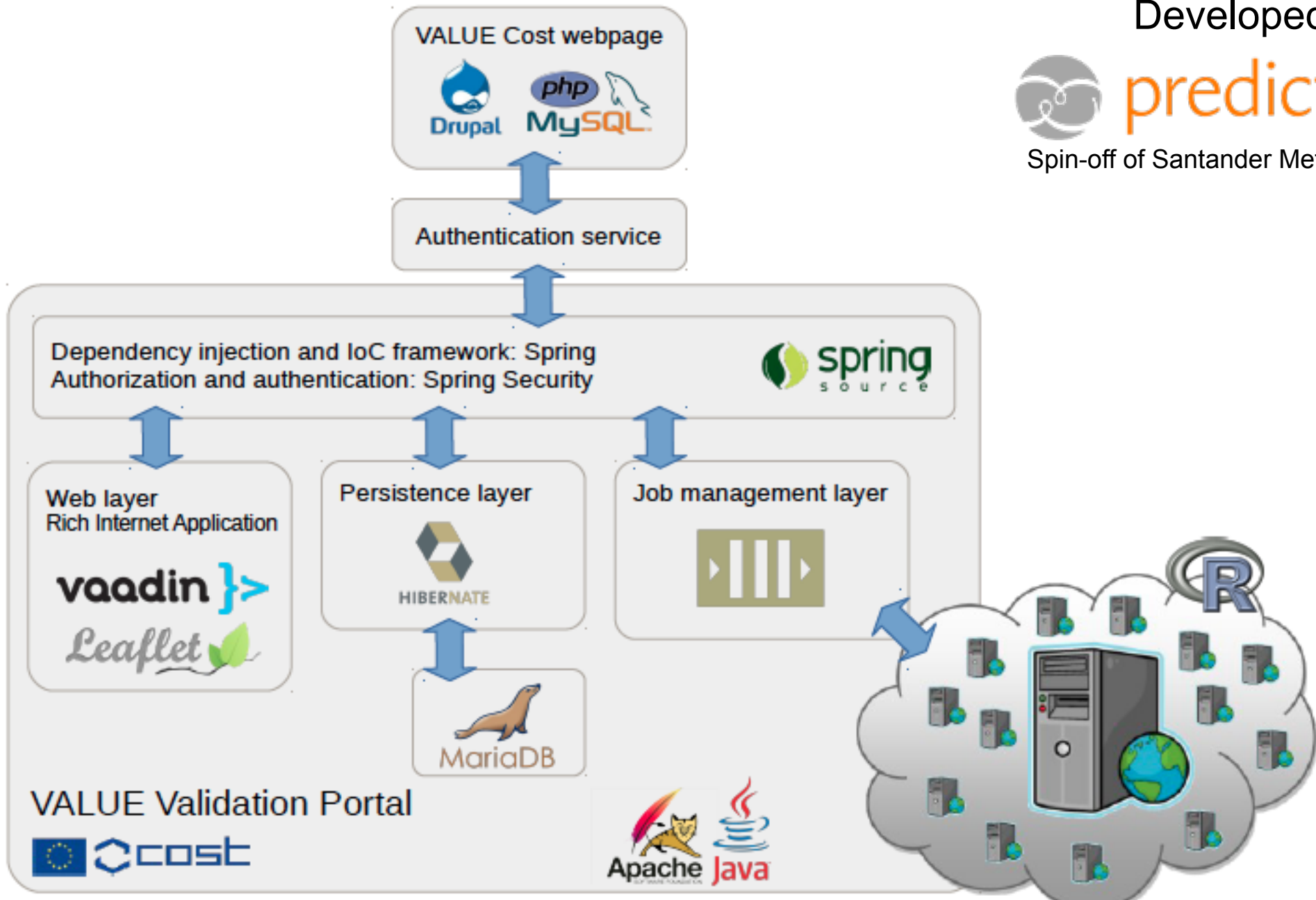
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Portal structure

Developed by:



Spin-off of Santander MetGroup



A **cross-validation framework** has been designed to validate the different downscaling techniques, identifying the different problems that might occur.

A **web portal** implementing this framework has been deployed to perform user-friendly automatic validation of different downscaling methods. Metadata is used in the validation process to decide the suitable validation indices for the different methods.

Conducting the largest (downscaling) validation and intercomparison experiment to date (**23 groups** so far). The first call (experiment 1) is open until April 2015.

Challenge... publication of the downscaled data with a proper metadata (ESGF).